UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF INTEGRATED MONITORING AND CONTROL SYSTEM FOR MUSHROOM CULTIVATION ON ENVIRONMENT AND FERTIGATION SYSTEM

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Penanaman cendawan yang boleh dimakan secara automatik adalah kaedah untuk menanam cendawan sesuai dengan keadaannya. Penanaman cendawan mempunyai banyak kelebihan dan sesuai untuk pertanian kerana ia digunakan dari produk sisa pertanian. Pengeluaran cendawan yang tinggi boleh didapati dari substrat yang disediakan dengan baik. Cendawan juga merupakan tanaman yang mempunyai nilai yang agak tinggi. Penanaman cendawan memberikan hasil yang sangat tinggi dengan mengawal suhu dan kelembapan persekitaran. Sistem yang terdiri daripada kipas, pam air dan mentol mudah dibina dan dikendalikan untuk mengawal keadaan alam sekitar dalam bekas yang tertutup.

ABSTRACT

The automated cultivation of edible mushroom is a method to grow mushrooms suit to its condition. Mushroom cultivation has many advantages and suit for farming because it is used from agricultural waste products. A high production of the mushrooms can be obtained from a well-prepared substrate. Mushrooms also are a very good cash crop. The development of the mushrooms production gives a very high yield by controlling the environment temperature and humidity. A system that consists of fan, water pump and bulb are easy to construct and manage to control the environment state in a close container.

DEDICATION

To my beloved parents, Othman Bin Kechik and to my mother Jamilah Binti Abdullah, I acknowledge my sincere gratitude to them for their love, dream and sacrifice throughout my life. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I never dream that I would go this far in life, their spirit and determination has inspired me to do so. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Today world has moved at the fast pace into modernisation and robotics in agriculture are a one of the futures of agricultural. It's also another mode to improve efficiency to developed agriculture needs. Created the intelligent machine to lessen and target energy inputs in more effective behaviors compare to the past. Meanwhile, care of farming has exposed the profits of this method, but we can now transfer towards a new generation of equipment. The start of autonomous system architectures gives us the chance to change a complete new range of agricultural equipment based on small smart machines that can be controlled in the right place, at the right time in the right way.

Cultivation of edible mushrooms is highly recommended in modern day as it increases production of food to feed the global population. New technology and method are applied in the cultivation of mushrooms. Mushrooms demand in suitable condition for them to growth in healthy condition. This chapter can review the cultivation system for mushrooms. The problem statement and problem background are defined subsequently. The paper based on a through by the useful of resource of research objectives and scope which includes the improvement of cultivation system with

automation that may be observed through monitoring system and much easier to grow mushrooms as its demand in suitable condition.

1.2 Project Background

This paper about a cultivation system for mushrooms in automated system as it constantly monitoring and analysing the condition of temperature, humidity and moisture of mushrooms. The technical software use in this project is Arduino as a microcontroller, temperature sensor, moisture sensor and EC sensor (electrical conductivity) as a primary input when related to Arduino for delivering the signal to get temperature condition and nutrient value. When sensor detect the situation of air, if the temperature is higher or lower than recommendation temperature, the Arduino will alert the sign and the subsequent relay will contact to give information to the water spray to lower the temperature or light up bulb to increase the temperature. As for substrate, different species of mushrooms required different substrate to growth.

Problem Statement

The standing of mushrooms cultivation has become immense challenge for farmers due to the criteria of the mushrooms itself. Cultivation system in mushrooms growth need special attention to several parameters such as temperature, humidity and the concentration of nutrient. Different species of mushrooms required different substrate for them to growth efficiently. Mushrooms is different than other plant as they are much choosier with their condition. In this modern day, most of people are too busy in their daily life and of course for those who were cultivating mushroom might not give enough attention toward the mushrooms. From this problem, it is necessary to make an automatic system to watch the condition of the mushrooms and controls their basic needed for them

to stay healthy. Apart from that, most of people cannot predict the condition of the mushrooms and how to maintain its condition.

1.3 Objectives

The objectives are a guideline in order to complete this project. There are several objective needs to achieve in this project:

1. To develop the system easily automatically and user-friendly control.
2. To monitor the surrounding of the mushrooms using Liquid Crystal Display (LCD).
3. To ensure the state of the mushrooms are at suitable condition.

1.4 Scope

There are several guidelines to propose for this project to ensure it will achieve the objectives:

1. Design the system by using ARDUINO UNO with sensors and put coding language for it to work automatically.
2. Install temperature and humidity sensor to monitor the surrounding and display it through Liquid Crystal Display (LCD).
3. Observe the growth of the mushrooms day by days to see the result obtained during the experiment.

1.5 Report Outline

This report contains five chapters and the outline of each chapter is explained as follows. Chapter 1 give out the introduction of the project that discusses the objectives, project advantages, problem statements and scope of the project and also an overview of the whole chapters in this report. Chapter 2 is the literature review of the project that is needed in order to complete the project that explains all the research information from the journals, article, books, and papers websites. Chapter 3 discuss about the methodology hardware and software of the project system. This chapter shows the planning of the project implementation and the details of the method that have being chosen. Chapter 4 will discuss all the result obtained and explains the progress process for the project and will show the apparatus involve accomplishing this project. Chapter 5 discusses the conclusion and summaries of the whole project system and future recommendation and some additional idea to improvement the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a short overview about the mushroom cultivation system. The researchers have gathered and accumulated previous studies, books, articles, and journals related to the design project entitled "Development of Integrated Monitoring & Control System for Mushroom Cultivation on Environment and Fertigation System". The collection of citations will be used as a reference in developing the proposed system.

2.2 Agriculture

Agriculture start independently in different part in the world and provide the basic needs of human by producing food, apparel, home, medication, and diversion. Thus, agriculture is the utmost crucial initiative in the world. It is a beneficial unit where the nature such as light, land, air, rain, temperature and humidity are interpreted into origin initial unit fundamentally for human beings. Secondary fruitful units are animals including birds, insects and livestock, feed on these primary units. Also, maintain concentrated products such as milk, meat, eggs, wools, silk and honey. Agriculture contribute feed, food, fuel, fibre, raw materials and furniture. Plus, resources for and from factories are provided an allowed fare and natural environment, ample food for driving out famine. Satisfactory agricultural production brings unity, prosperity, kinship, wealth and health to personal of a nation by eradicate doubt, anarchy and discord. It supports to elevate the civic consisting of different order and clauses; hence it will lead to a preferred

social, political, cultural and economic life. Agricultural progress can be considered as multidirectional that having sprint speed and rapid advance with respect to space and time. Farmers started enhance cultural trainings and agricultural inputs in in-deep cropping systems with fulfil intensive programmed to build-up the production significantly. It helps suitable environment to all these better-quality genotypes to feed and manifest their yield latent in newer area. Agriculture lie of rising plants and breed animals in order to yield and it helps to preserve a biological stability in nature.

2.3 Mushroom Cultivation

The cultivation system is a technical process that consists of several successive steps in order to make the system flows smoothly. Mushrooms culture contains several diverse preparations, each of which need to be wisely performed. Preparation of substrate, inoculation, incubation, and production situations depend on the mushroom species that need to be cultivated.(Sánchez, 2010)

2.3.1 Compositing

Compost is the starter in a growing cycle of mushrooms. In compost preparation, manure is at starting. The compost factories get the manure from a horse breeding corporation then pay the compost factories to gather the manure obtained. Gypsum, chicken manure, straw and water are the composition in the manure. The two manure which are straw and mineral are the nutrients to improves the structure and gives the right acidity. The compost is made in tunnels so as to forestall the smell from changing into a nuisance. As manure produce ammonia gas, compost factories will

purify the air with ammonia wash to decrease the emission of gases. The indoor compost appears like earth from the woods. Dark brown, filled with damaged bits of straw. The compost also is steaming, because of the composting process: heat is generated that digests the parts. What's left is a terribly fertile, nutritive source for mushrooms. On one batch of compost, two to a few flushes of mushrooms are often fully grown. A square meter of compost (which is adequate 90 kilos) yields a most of 35 kilos of mushrooms. At that time, it's not lucrative to utilize the compost. The leftover compost will still be used as a soil conditioner in different agricultural corporations.

Figure 2.1: Composting

2.3.2 Spawning

The indoor fresh compost is treated in a tunnel at 56-60 degrees Celsius. All bacteria are likely killed. The compost stays in the tunnel for six days to reach mature state, when the compost is diverse with spawn that will yield the mycelium from the mushrooms. Then the compost is transferred to another tunnel so the mycelium can spread each other through the compost. The mycelium grows rapidly because within two weeks it has completely permeated the compost, which means that the mycelium has grasped

the point that it is prepared for the growers. At this time the compost looks like light brown peat. Most of the mushroom growers do not yield their own spawn, because it is a classy process. Then the spawn is produced by inoculating grain with spores in specialized companies. The grain is treated to avoid infection and it's kept as the mushrooms like a moist condition. Five hundred kilos of inoculated grain (1100 pounds) are been delivered from ten kilo of spores (22 pounds). The grain then is incubated in a bag for almost two weeks at 25 degrees Celsius (75 degrees Fahrenheit) approximately, then it will be moved to a freezer at 3 degrees Celsius (35 degrees Fahrenheit) to harden the spawn. From this way, the spawn will get a shelf life of 6 months long without the mycelium losing its vitality.

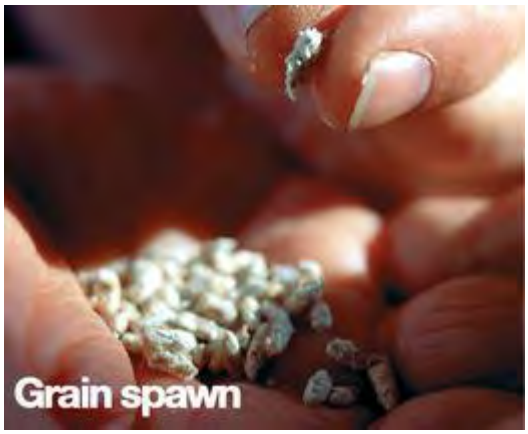

Figure 2.2: Spawning

2.3.3 Casing

The matured compost is spread and put it in the mushroom beds that made from long stainless-steel boxes. The beds are placed inside special dark rooms which is called cells to prevent pinning at early stage. The temperature in the cells is adjusted suitable for the mushrooms at about 23 degrees Celsius. To preserve the compost moist, a layer of

peat casing material is added on top of the compost. In six days, 20 to 24 liters of water is given on each cell to increase the moisture because more moisture is needed. Then, the fungus has about two days to grow through the covering layer of casing soil.

2.3.4 Pinning

Autumn is a season that most wild mushrooms are likely to grow. However, autumn condition can be created to cultivate the mushroom along the years. Therefore, over four days the temperature is lowered around 17 to 23 degree Celsius in the cells. When the mycelium has grown to its maximum extent, the temperature will start to be lowered. When the mycelium starts to sprout the mushrooms, the temperature shock will occur as the sign. The same thing also happens in nature. In autumn weather, the mycelium grows well and after a storm, the mushrooms will start to appear. Little buds will be formed from the mycelium, which will turn into mushrooms. Those little white buds are called pins. In this stage, air temperature and humidity can influence the growth of the mushrooms. Short amount of air temperature and low humidity will yield more buds, which yield smaller mushrooms. Large amount air temperature and humidity will yield fewer but larger mushrooms.